VTT Technical Research Centre of Finland

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HefCel technology

High-consistency enzymatic fibrillation (HefCel) technology offers a cost-efficient way to produce fibrillated cellulose materials at high consistency (20-40%). The process is simple, consisting only of few steps and can utilize existing industrial equipment. The fibrillation degree and thus the material properties can be controlled by the process conditions. The produced fibrillated cellulose material is at high consistency and easy to handle. The higher dry matter content makes off-site production and transportation more feasible compared to traditional CNFs. In addition, HefCel material is not gel-like, which enhances the water removal.

Recent developments

Recent developments in HefCel technogy include processing of new raw materials, novel applications for the material as well as investment in new equipment at VTT to enable up-scaling of the technology.

New raw materials

The new raw materials tested include for example soda-ethanol pulps produced from Argentinian pine chips, processed in ERANET-LAC project “ValBio-3D: Valorization of residual biomass for advanced 3D materials”. Despite of some lignin remaining in the pulps, the enzymatic fibrillation succeeded, especially when the oxygen-delignified pulp was treated (Figure 1).

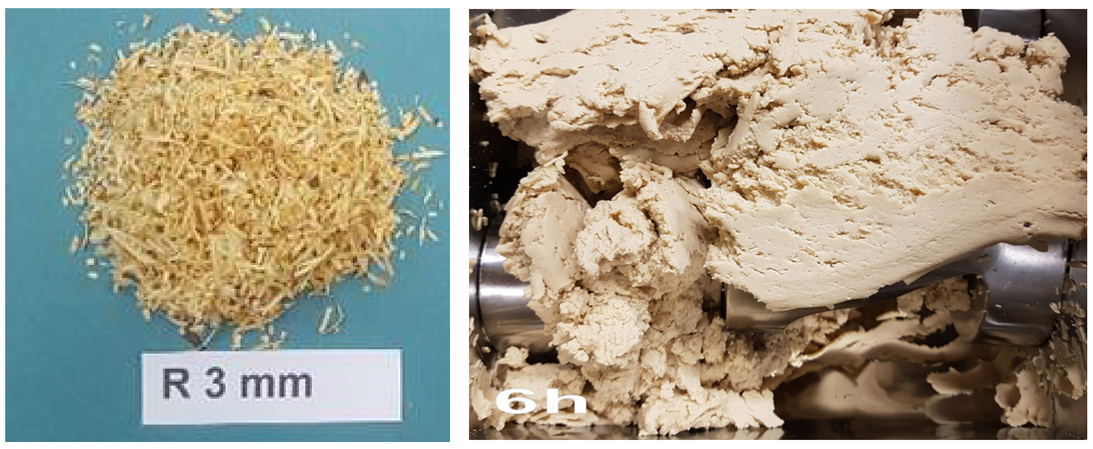

Figure 1. *Pine sawdust raw material (on the left) and HefCel CMF produced from pine sawdust soda-ethanol O_2 bleached pulps (on the right).*

Up-scaling

One important aspect of any new processing technology is its feasibility for up-scaling and commercial production. One step towards large-scale HefCel production will be taken later this year when a new mixer with a capacity of 70 l is installed at VTT. Operating the process at this scale will result in a more detailed information about the technical and economic feasibility of the technology.

Novel applications

HefCel material has shown potential in many applications, such as in barrier films, as strengthening additive in middle ply of board and in novel type of energy storages. One novel application utilizing the excellent oxygen, grease and gas barrier properties of cellulose nanomaterial films is an all-cellulosic packaging material from HefCel and fatty acid esters. It is a 3-layer barrier film structure consisting of two layers of thermoplastic cellulose with a HefCel film layer sandwiched in-between. Thermoplastic cellulose films act as moisture and water vapour barrier as well as enables heat sealing. The material is 100% renewable, recyclable and processable with existing machinery (Figure 2).

Figure 2. *Three-layer cellulose film consisting of thermoplastic cellulose and HefCel CNF.*

Conclusions

- **HefCel technology is a cost-effcient method to produce CMF/CNF at high consistency.**
- **HefCel technology is suitable for various raw materials, including soda-ethanol pulps from pine sawdust.**
- **Novel HefCel applications include a 3-layer barrier film, combination of HefCel CNF and thermoplastic cellulose.**
- **Up-scalability of HefCel production will be studied later this year when a new mixer is installed.**

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